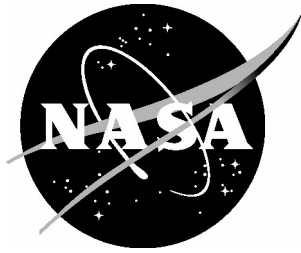


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Definitions of Tactical and Strategic: An Informal Study

Paul C. Schutte
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November 2004

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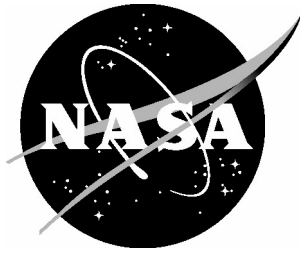
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Introduction

In aviation, the terms tactical and strategic are used quite often to describe behaviors and activities on the flight deck. Jonnson and Ricks (Jonsson & Ricks, 1993) found that pilots tended to categorize flight deck information along a tactical and strategic dimension. Tactical behaviors are generally considered to be near-term, dynamic activities while strategic behaviors are generally considered to be long-term and big-picture activities. As will be seen in this paper, the discriminators between tactical and strategic vary depending on context and individual. In personal conversations with designers at US airframe and avionics manufacturers, the designers have claimed that the Flight Management System (FMS) and the Cockpit Display Unit (CDU) have been designed primarily for strategic use and the control inceptor (either wheel-and-column or side-stick), throttle, and mode control panel (MCP) are to be used for tactical activity. Designers reason that the FMS CDU (a device located in the lower center of the flight deck that uses a keyboard interface) is for strategic use because it requires the pilot to divert his attention from the primary flight display (PFD) and take his hands off of the controls to operate. Thus, he cannot focus on the dynamic control of the aircraft while operating the FMS.

Does the FMS exclusively provide controls and display for strategic behavior and the PFD, inceptor, throttle, and MCP exclusively provide controls and display for tactical behavior? Before this question can be answered, we need to have a better understanding of what is meant by the terms *tactical* and *strategic*. However, the manufacturers do not have these terms strictly defined. The definitions are assumed to be understood. While many people claim to understand the terms, do they agree on the definition? Can the definitions be put into crisp terms? The obvious place to begin to look is the dictionary. However, standard dictionary definitions do little to shed light on this distinction.

Tactical:

- 1 : of or relating to combat tactics : as
 - a** (1) : of or occurring at the battlefield <*tactical defense*> <*tactical first strike*> (2) : using or being weapons or forces employed at the battlefield <*tactical missiles*>
 - b** of an air force : of, relating to, or designed for air attack in close support of friendly ground forces
- 2 **a** : of or relating to tactics : as (1) : of or relating to small-scale actions serving a larger purpose (2) : made or carried out with only a limited or immediate end in view
 - b** : adroit in planning or maneuvering to accomplish a purpose

Strategic:

- 1 : of, relating to, or marked by strategy <*a strategic retreat*>
- 2 **a** : necessary to or important in the initiation, conduct, or completion of a strategic plan
 - b** : required for the conduct of war and not available in adequate quantities domestically <*strategic materials*>
 - c** : of great importance within an integrated whole or to a planned effect <*emphasized strategic points*>
- 3 : designed or trained to strike an enemy at the sources of his military, economic, or political power <*a strategic bomber*> (Merriam, 1976)

For tactical, definition 2a seems closest to how the term is used in aviation. For strategic, 2c seems most appropriate. However, these definitions do not imply dichotomy or an exclusiveness between tactical and strategic. For example, both definitions talk of planning. Could this overlap in definitions lead to a confusion on the flight deck?

The purpose of this study, therefore, was to explore the differences between tactical and strategic behavior based on verb descriptors. An informal survey was given to subject matter experts (SME) in the aviation domain. These included pilots, avionics designers, airframers, and researchers. The SMEs were asked to list five verbs that described “tactical behavior” and five verbs that described “strategic behavior.” Then they were given the opportunity to describe each behavior in a few sentences.

Method

Subjects

Twenty subjects received the questionnaire. Seventeen subjects responded. Eleven of the respondents were NASA researchers in the flight deck and flight management areas. Five respondents were flight deck designers for major US aircraft manufacturers. Two respondents were designers for a US avionics manufacturer. One respondent was a retired pilot for a major US airline. Of the respondents, eight had at least a private pilot instrument rating. Sixteen of the respondents were natives of the United States with English as their first language. One respondent was a German-born US citizen whose first language was German but was fluent in English. Appendix A provides a brief description of each SME.

Questionnaire

The subjects were given the following request in an email. They were asked to respond within a week.

Thank you for participating in this study. I am interested in better defining the meanings of the terms tactical and strategic with regard to flight deck operations and behaviors. To that end I am soliciting your opinions regarding these terms. Please respond to the instructions below.

For 'TACTICAL', please write down the first five verbs that come to your mind.

Then write down a sentence or two describing what tactical behavior is on the flight deck

For 'STRATEGIC', please write down the first five verbs that come to your mind.

Then write down a sentence or two describing what strategic behavior is on the flight deck

Results

Verb Descriptions

As is often the case in such surveys, not all SMEs responded with five verbs and some responded with adjectives and adverbs. When possible, these adjectives and adverbs were translated into corresponding verbs based on their definitions in the dictionary. There were eight verbs that appeared in both tactical and strategic descriptions. These were evaluate, decide, react, navigate, perceive, manage, direct, and get information. Many of the other verbs had similar meaning such as do, perform, and act. To address these similarities, the dictionary definition (Merriam, 1976) was used for clarification. Not surprisingly, many of the verbs were used in the definition of other verbs. Table 1 lists all the verbs that were listed by the SMEs as describing strategic behavior along with their corresponding definitions. If a verb was directly mentioned or alluded to in the definition of another strategic verb, it is printed in a bold font. Nouns and adjectives were mapped to their verb counterparts (e.g., develop an understanding was mapped to the verb to understand, and intention and intended were mapped to the verb to intend). Table 2 presents the same verbs along with the number of times that verb was directly cited by SMEs, the number of times that the verb appeared (or was alluded to) in a definition for other strategic verbs, and the number of times that the verb was listed either directly or in a definition for a tactical verb. If a verb was mentioned more than once in a definition (e.g., perceive is mentioned twice in the definition for know), it was only counted once. Tables 3 and 4 contain the corresponding data for the tactical verbs. The starred (*) verbs are those found in both tactical and strategic descriptions.

TABLE 1

Verbs describing “strategic behavior” along with the corresponding definitions. If a strategic verb is cited or alluded to in the definition of another strategic verb, it is printed in bold font. The starred (*) verbs were cited by SMEs in both the tactical and the strategic verbs.

Verb	Definitions
plan	<ol style="list-style-type: none"> 1. To formulate a scheme or program for the accomplishment, enactment, or attainment of 2. To have as a specific aim or purpose; intend 3. To draw or make a graphic representation of
think	<ol style="list-style-type: none"> 1. To have or formulate in the mind 2. a. To reason about or reflect on; ponder b. To decide by reasoning, reflection, or pondering 3. To judge or regard; look upon 4. To believe; suppose 5. a. To expect; hope b. To intend 6. To call to mind; remember 7. To visualize; imagine 8. To devise or evolve; invent 9. To bring into a given condition by mental preoccupation 10. To concentrate one's thoughts on
evaluate *	<ol style="list-style-type: none"> 1. To ascertain or fix the value or worth of 2. To examine and judge carefully; appraise 3. Mathematics. To calculate the numerical value of; express numerically
anticipate	<ol style="list-style-type: none"> 1. To feel or realize beforehand; foresee 2. To look forward to, especially with pleasure; expect 3. To act in advance so as to prevent; forestall 4. To foresee and fulfill in advance 5. To cause to happen in advance; accelerate
prioritize	<ol style="list-style-type: none"> 1. To arrange or deal with in order of importance 2. To put things in order of importance
decide *	<ol style="list-style-type: none"> 1. To settle conclusively all contention or uncertainty about 2. To influence or determine the outcome of 3. To cause to make or reach a decision
project	<ol style="list-style-type: none"> 1. To thrust outward or forward 2. To throw forward; hurl 3. To send out into space; cast 4. To cause (an image) to appear on a surface 5. To form a plan or an intention for 6. To calculate, estimate, or predict (something in the future), based on present data or trends
optimize	<ol style="list-style-type: none"> 1. To make as perfect or effective as possible 2. To make the most of
prepare	<ol style="list-style-type: none"> 1. To make ready beforehand for a specific purpose, as for an event or occasion 2. To put together or make by combining various elements or ingredients; manufacture or compound 3. To fit out; equip
get info *	No explicit definition available
react *	<ol style="list-style-type: none"> 1. To act in response to or under the influence of a stimulus or prompting 2. To act in opposition to a former condition or act 3. To act reciprocally or in return
rationalize	<ol style="list-style-type: none"> 1. To make rational 2. To interpret from a rational standpoint 3. To devise self-satisfying but incorrect reasons for (one's behavior)

navigate *	1. To plan , record, and control the course and position of (a ship or an aircraft) 2. To follow a planned course on, across, or through
devise	To form, plan, or arrange in the mind; design or contrive
schedule	1. To enter on a schedule 2. To make up a schedule for 3. To plan or appoint for a certain time or date
learn	1. To gain knowledge, comprehension, or mastery of through experience or study 2. To fix in the mind or memory; memorize 3. a. To acquire experience of or an ability or a skill in b. To become aware 4. To become informed of; find out
know	1. To perceive directly; grasp in the mind with clarity or certainty 2. To regard as true beyond doubt 3. To have a practical understanding of, as through experience; be skilled in 4. To have fixed in the mind 5. To have experience of 6. a. To perceive as familiar; recognize b. To be acquainted with 7. To be able to distinguish; recognize as distinct 8. To discern the character or nature of
compare	1. To consider or describe as similar, equal, or analogous; liken 2. To examine in order to note the similarities or differences of
get ready	No explicit definition available
designate	1. To indicate or specify; point out 2. To give a name or title to; characterize 3. To select and set aside for a duty, an office, or a purpose
map	1. a. To make a map of b. To depict as if on a map 2. To explore or make a survey of (a region) for the purpose of making a map 3. To plan or delineate, especially in detail; arrange
arrange	1. To put into a specific order or relation; dispose 2. To plan or prepare for 3. To bring about an agreement concerning; settle
execute	1. To put into effect; carry out 2. To perform; do 3. To create in accordance with a prescribed design 4. To make valid, as by signing 5. To perform or carry out what is required by
predict	To state, tell about, or make known in advance, especially on the basis of special knowledge
monitor	1. To check the quality or content of (an electronic audio or visual signal) by means of a receiver 2. To check by means of an electronic receiver for significant content, such as military, political, or illegal activity 3. To keep track of systematically with a view to collecting information 4. a. To test or sample on a regular or ongoing basis b. To test (air or an object's surface, for example) for radiation intensity 5. To keep close watch over; supervise 6. To direct
think ahead	No explicit definition available
manage *	1. To direct or control the use of; handle 2. a. To exert control over b. To make submissive to one's authority, discipline, or persuasion 3. To direct the affairs or interests of 4. To succeed in accomplishing or achieving, especially with difficulty; contrive or arrange
elaborate	1. To work out with care and detail; develop thoroughly 2. To produce by effort; create

establish	<ol style="list-style-type: none"> 1. a. To set up; found b. To bring about; generate 2. a. To place or settle in a secure position or condition; install b. To make firm or secure 3. To cause to be recognized and accepted 4. To introduce and put (a law, for example) into force 5. To prove the validity or truth of
proceduralize	No explicit definition available
order	<ol style="list-style-type: none"> 1. To issue a command or an instruction to 2. To give a command or an instruction for 3. To direct to proceed as specified 4. To give an order for; request to be supplied with 5. To put into a methodical, systematic arrangement
perceive *	<ol style="list-style-type: none"> 1. To become aware of directly through any of the senses, especially sight or hearing. 2. To achieve understanding of; apprehend
consider	<ol style="list-style-type: none"> 1. To think carefully about 2. To think or deem to be; regard as 3. To form an opinion about; judge 4. To take into account; bear in mind 5. To show consideration for 6. To look at thoughtfully
understand	<ol style="list-style-type: none"> 1. To perceive and comprehend the nature and significance of; grasp 2. To know thoroughly by close contact or long experience with 3. a. To grasp or comprehend the meaning intended or expressed by another b. To comprehend the language, sounds, form, or symbols of 4. To know and be tolerant or sympathetic toward 5. To learn indirectly, as by hearsay 6. To infer 7. To accept (something) as an agreed fact 8. To supply or add (words or a meaning, for example) mentally
integrate	<ol style="list-style-type: none"> 1. To make into a whole by bringing all parts together; unify 2. a. To join with something else; unite b. To make part of a larger unit
plot	<ol style="list-style-type: none"> 1. To represent graphically, as on a chart 2. To conceive and arrange the action and incidents of
formulate	<ol style="list-style-type: none"> 1. a. To state as or reduce to a formula. b. To express in systematic terms or concepts. c. To devise or invent 2. To prepare according to a specified formula
inquire	<ol style="list-style-type: none"> 1. To seek information by asking a question 2. To make an inquiry or investigation
rehearse	<ol style="list-style-type: none"> 1. a. To practice in preparation for a public performance b. To direct in rehearsal 2. To perfect or cause to perfect (an action) by repetition 3. a. To retell or recite b. To list or enumerate
direct *	<ol style="list-style-type: none"> 1. To manage or conduct the affairs of; regulate 2. To have or take charge of 3. To give authoritative instructions to 4. To cause to move toward a goal; aim 5. To show or indicate the way for 6. To cause to move in or follow a straight path 7. To indicate the intended recipient on (a letter, for example) 8. To address or adapt (remarks, for example) to a specific person, audience, or purpose 9. a. To give guidance and instruction to (actors or musicians, for example) in the rehearsal and performance of a work b. To supervise the performance of
modify	<ol style="list-style-type: none"> 1. To change in form or character; alter 2. To make less extreme, severe, or strong
allocate	<ol style="list-style-type: none"> 1. To set apart for a special purpose; designate 2. To distribute according to a plan; allot

intend	1. To have in mind; plan 2. a. To design for a specific purpose b. To have in mind for a particular use 3. To signify or mean
analyze	To separate into parts or basic principles so as to determine the nature of the whole; examine methodically

TABLE 2

Verbs describing “strategic behavior” along with their corresponding response counts. The starred (*) verbs were cited by SMEs in both the tactical and the strategic verbs. The second column (# of responses) lists the number of times SME listed the verb as an example of strategic behavior. The third column (# of references in def.s for other strategic verbs) lists the number of times this verb was mentioned or alluded to in other strategic verb definitions. The fourth column (# of references in def.s for tactical verbs) lists the number of times this verb was mentioned or alluded to in the tactical verb definitions (Table 3).

Verb	# of responses	# of references in def.s for other strategic verbs	# of references in def.s for tactical verbs
plan	13	8	1
think	5	2	0
evaluate *	3	0	1
anticipate	3	0	0
prioritize	2	0	0
decide *	2	1	1
project	2	0	0
optimize	1	0	0
prepare	1	2	1
get info *	1	0	1
react *	1	0	2
rationalize	1	0	0
navigate *	1	0	1
devise	1	3	0
schedule	1	0	0
learn	1	1	0
know	1	1	2
compare	1	0	0
get ready	1	0	0
designate	1	1	0
map	1	0	0
arrange	1	6	1
execute	1	0	1
predict	1	1	0
monitor	1	0	0
think ahead	1	0	0
manage *	1	1	2
elaborate	1	0	0
establish	1	0	0
proceduralize	1	0	0
order	1	3	1
perceive *	1	2	2
consider	1	1	1
understand	1	2	2
integrate	1	0	0
plot	1	0	0
formulate	1	5	0

inquire	1	0	0
rehearse	1	0	0
direct *	1	4	6
modify	1	0	0
allocate	1	0	0
intend	1	5	0
analyze	1	0	0

TABLE 3

Verbs describing “tactical behavior” along with the corresponding definitions. If a tactical verb is cited or alluded to in the definition of another tactical verb, it is printed in bold font. The starred (*) verbs were cited by SMEs in both the tactical and the strategic verbs.

Verb	Definition
respond	1. To make a reply; answer 2. To act in return or in answer. 3. To react positively or favorably
act	1. To behave or comport oneself 2. To perform in a dramatic role or roles 3. To be suitable for theatrical performance 4. To behave affectedly or unnaturally; pretend 5. To appear or seem to be 6. To carry out an action 7. To operate or function in a specific way 8. To serve or function as a substitute for another 9. To produce an effect
react *	1. To act in response to or under the influence of a stimulus or prompting 2. To act in opposition to a former condition or act 3. To act reciprocally or in return
do	1. a. To perform or execute b. To fulfill the requirements of c. To carry out; commit 2. a. To produce, especially by creative effort b. To play the part or role of in a creative production c. To mimic 3. a. To bring about; effect b. To render; give 4. To put forth; exert 5. a. To attend to in such a way as to take care of or put in order b. To prepare for further use especially by washing 6. To have as an occupation or a profession 7. To work out by studying
fly ¹	1. To engage in flight, especially a. To move through the air by means of wings or winglike parts b. To travel by air c. To operate an aircraft or spacecraft 2. a. To rise in or be carried through the air by the wind b. To float or flap in the air 3. To move or be sent through the air with great speed 4. a. To move with great speed; rush or dart b. To flee; escape c. To hasten; spring
control	1. To exercise authoritative or dominating influence over; direct 2. To hold in restraint; check 3. a. To verify or regulate (a scientific experiment) by conducting a parallel experiment or by comparing with another standard b. To verify (an account, for example) by using a duplicate register for comparison
avoid	1. To stay clear of; shun 2. To keep from happening
maneuver	1. To alter the tactical placement of (troops or warships) 2. To direct through a series of movements or changes in course 3. To manipulate into a desired position or toward a predetermined goal

evaluate *	1. To ascertain or fix the value or worth of 2. To examine and judge carefully; appraise 3. Mathematics. To calculate the numerical value of; express numerically
perceive *	1. To become aware of directly through any of the senses, especially sight or hearing 2. To achieve understanding of; apprehend
get info *	No explicit definition available
decide *	1. To settle conclusively all contention or uncertainty about 2. To influence or determine the outcome of 3. To cause to make or reach a decision
direct *	1. To manage or conduct the affairs of; regulate 2. To have or take charge of 3. To give authoritative instructions to 4. To cause to move toward a goal; aim 5. To show or indicate the way for 6. To cause to move in or follow a straight 7. To indicate the intended recipient on (a letter, for example) 8. To address or adapt (remarks, for example) to a specific person, audience, or purpose 9. a. To give guidance and instruction to (actors or musicians, for example) in the rehearsal and performance of a work b. To supervise the performance of
intercede	1. To plead on another's behalf 2. To act as mediator in a dispute
aviate	To operate an aircraft; fly
communicate	1. a. To convey information about; make known; impart b. To reveal clearly; manifest 2. To spread to others; transmit
correct	1. a. To remove the errors or mistakes from b. To indicate or mark the errors in 2. To remove, remedy, or counteract (a malfunction, for example) 3. To adjust so as to meet a required standard or condition
manage *	1. To direct or control the use of; handle 2. a. To exert control over b. To make submissive to one's authority, discipline, or persuasion 3. To direct the affairs or interests of 4. To succeed in accomplishing or achieving, especially with difficulty; contrive or arrange
compensate	1. To offset; counterbalance 2. To make satisfactory payment or reparation to; recompense or reimburse
perform	1. To begin and carry through to completion; do 2. To take action in accordance with the requirements of; fulfill 3. a. To enact (a feat or role) before an audience b. To give a public presentation of; present
accomplish	1. To succeed in doing; bring to pass 2. To reach the end of; complete
observe	1. To be or become aware of, especially through careful and directed attention; notice 2. To watch attentively 3. To make a systematic or scientific observation 4. To say casually; remark 5. To adhere to or abide by
move	1. To change in position from one point to another 2. To progress in sequence; go forward 3. To follow a specified course 4. To progress toward a particular state or condition 5. To start off; depart 6. To change posture or position; stir 7. To be put in motion or to turn according to a prescribed motion. Used of machinery 8. To exhibit great activity or energy 9. To initiate an action ; act

carry out	1. To put into practice or effect 2. To follow or obey 3. To bring to a conclusion; accomplish
concentrate	1. a. To converge toward or meet in a common center b. To increase by degree; gather 2. To direct one's thoughts or attention
see	1. To perceive with the eye 2. a. To apprehend as if with the eye b. To detect by means analogous to use of the eye 3. To have a mental image of; visualize 4. To understand; comprehend 5. To consider to be; regard 6. To believe possible; imagine 7. To foresee 8. To know through firsthand experience; undergo 9. To give rise to or be characterized by 10. To find out; ascertain
take emergency action	No explicit definition available
point	1. To direct or aim 2. To bring (something) to notice 3. To indicate the position or direction of
assess	To determine the value, significance, or extent of; appraise
implement	To put into practical effect; carry out
navigate *	1. To plan, record, and control the course and position of (a ship or an aircraft) 2. To follow a planned course on, across, or through
generate	1. a. To bring into being; give rise to b. To produce as a result of a chemical or physical process

¹ Many respondents listed different aspects of flying such as “turn,” “roll,” “dive,” and “climb.” Where a respondent listed multiple verbs related to flying the aircraft, it was counted as one response.

TABLE 4

Verbs describing “tactical behavior” along with their corresponding response counts. The starred (*) verbs were cited by SMEs in both the tactical and the strategic verbs. The second column (# of responses) lists the number of times SME listed the verb as an example of tactical behavior. The third column (# of references in def.s for other tactical verbs) lists the number of times this verb was mentioned or alluded to in other tactical verb definitions. The fourth column (# of references in def.s for strategic verbs) lists the number of times this verb was mentioned or alluded to in the strategic verb definitions (Table 1).

Verb	# of responses	# of references in def.s for other tactical verbs	# of references in def.s for strategic verbs
respond	6	1	1
act	6	7	2
react *	5	1	1
do	5	1	1
fly ¹	5	1	0
control	4	2	2
avoid	4	0	0
maneuver	2	0	0
evaluate *	2	0	1
perceive *	1	1	3
get info *	1	0	1
decide *	1	0	2
direct *	1	5	6
intercede	1	0	0
aviate	1	0	0

communicate	1	0	0
correct	1	0	0
manage *	1	1	2
compensate	1	0	0
perform	1	2	1
accomplish	1	2	1
observe	1	0	0
move	1	3	1
carry out	1	1	0
concentrate	1	0	1
see	1	0	0
take emergency action	1	0	0
point	1	0	1
assess	1	0	0
implement	1	0	0
navigate *	1	0	1
generate	1	0	0

Sentence Descriptions

The SMEs were allowed to describe what they meant by tactical and strategic in a few sentences. Excerpts from these comments that the author found particularly interesting are given below. The entire set of responses can be found in Appendix B

Strategic

“... thinking ahead of the airplane, mission & flight planning, setting long term goals and plans for accomplishing goals, knowledge-based reasoning about issues/plans/problems, contingency planning, anticipating future events — concern about future states and situations vs. current states and situations.”

“Primary distinguishing factor: focus on near term vs. far term goals & tasks — not sure what the magic number is for time, but probably in the neighborhood of <5 minutes (maybe as low as <2 minutes) is tactical. Secondary distinguishing factor: workload/ number of tasks requiring immediate attention.”

“... strategic behavior derives from the mission and serves to identify the methods, and (lower) actions required to accomplish this mission; this can include strategies for contingencies. strategic FPM (Flight Path Management) includes route planning, identifying contingency conditions and methods for coping with them....”

“Strategic behavior in the cockpit is planning for flight tasks/maneuvers in the future not ones currently happening. Strategic behavior is more proactive than reactive because there is time to plan for future flight tasks maneuvers.”

"Actions or plans related to long-term goals"

“Strategic requirements, tasks and behaviors relate to situation awareness — the integrated understanding and correlation of the myriad of variables that affect vehicle flight path and systems management. Strategic issues focus on the rationale for present and future actions, and relationships between present and future requirements.”

“Strategic behavior is deciding what appropriate actions should be taken later on — long range planning, reviewing approach, missed approach, and landing procedures, planning contingencies or what-ifs, etc.”

“Planning the future state of the vehicle. This would include navigation (where am I going) and guidance (how do I get there).”

“Strategic behavior on the flight deck is characterized by a long-term focus (with respect to the duration of the flight), as in planning the route and responding to major events which render existing plans unworkable or undesirable.”

“... much strategic behavior takes place before entering the cockpit. It probably begins with learning the time and destination of the flight. This initiates a cognitive review that includes study of the airports, routes, probable weather and special procedures. The strategic behavior continues during the flight planning period with consideration to weather, airplane condition and crew considerations. Once airborne, strategic and tactical considerations are often inseparable.”

“... strategy is what you do when there's nothing to do (e.g., prepare for approach/landing during cruise, preflight brief, flight plan, etc.)”

“Strategic behaviors on the flight deck are any part of a series of operations or procedures used to achieve large-scale and lasting objectives.”

“Strategic behavior on the flight deck means planning in advance for all or long (> 20 minutes) portions of the trip — taking into account anticipated conditions — and setting nav/com/fms for those planned intentions.”

Tactical

“... relates to immediate tasks, setting and accomplishing short-term goals, performing and responding quickly without time for knowledge-based reasoning, high workload situations in which pilot attention and workload is focused on accomplishing items with near-in deadlines, working in "real time.””

“tactical behavior includes all immediate activity in response to external stimuli and required as a means of accomplishing pre-established goals pertaining to a strategy.”

“... flight tasks/maneuvers currently in progress or ones in the immediate future. Tactical behavior is reactionary.”

“... associated with direct control of the vehicle — what it is that the pilot needs to do to directly affect the flight path or critical systems. Tactical requirements are often immediate, and emphasize what it is that needs to be done, rather than the rationale for doing it.”

“Tactical behaviors are near-term or current action — means to fly (aviate) the airplane. Keep it right-side up. To navigate — what actions are required to fly a specific heading or to attain a specific altitude or vertical speed or to attain a specific airspeed.”

“Tactical behavior is the identification of a circumstance/situation/condition with near-term implications and the implementation of a trained/pre-established response to rapidly mitigate the situation.”

“Controlling the current state of the vehicle. This would include navigation (where am I) and guidance (where should I be and how do I get there).”

“Tactical behavior is that of flying the airplane. This will include all airplane maneuvering with the primary flight controller and throttles. It includes use of autopilot, changes to the airplane configuration, and communications with ATC.”

“... tactics are what you do when you have to do something (e.g., climb, descend, avoid hitting an aircraft, report in, respond to ATC)”

“... describing current activities”

“Tactical behaviors on the flight deck are short-term, expeditious techniques to achieve a limited or temporary advantage.”

“Tactical behavior on the flight deck means reacting to unexpected events, revising plans over short time periods (less than 20 minutes), involves actually controlling the plane, to carry out those revised plans.”

Summary

Each verb descriptor was scored in the following manner to produce its discriminative value. For each verb the score was equal to the number of times explicitly cited plus the number of times the verb was cited in a definition of the same class minus the number of times the verb was cited in the opposing category either directly or indirectly minus 1 if the verb was directly cited. The formula for computing the score follows.

$$\begin{aligned}\text{Discriminative Value Score} = & (\# \text{ of responses}) \\ & + (\# \text{ of references in def.s for other same category verbs}) \\ & - (\# \text{ of references in def.s for strategic verbs}) \\ & - (1 \text{ if verb listed in both tactical and strategic})\end{aligned}$$

The purpose of this scoring was to determine strong discriminators between the two behaviors. If a verb was cited many times by the SMEs, that would indicate that it was very descriptive of that category. Similarly, if the verb was cited in the other definitions of verb descriptors it should be even more descriptive. The more descriptive a verb is, the greater the chances of it being a good discriminator. However, if the verb was cited in the opposite category's definitions or descriptor verbs, this would imply that it was not a good discriminator and it decreased the discrimination value score. Finally, if a verb was cited in both tactical and strategic, an additional point was subtracted because that meant that it had less discriminative value. If a verb was cited often in both, then the net result would be closer to zero meaning that it had little value as a discriminator¹. Table 5 shows the scores for the strategic verbs. Table 6 shows the scores for the tactical verbs.

¹ This is not to say that the verb does not describe the behavior. It simply states that it is common in both behaviors and therefore does not discriminate between the two.

TABLE 5
Strategic verb discriminative value scores.

Verbs	Score
Plan	20
Think	7
Arrange, Formulate, Intend	6
Devise	4
Anticipate, Order	3
Designate, Learn, Predict, Prepare, Prioritize, Project	2
Allocate, Analyze, Compare, Consider, Decide, Elaborate, Establish, Evaluate, Get Ready, Inquire, Integrate, Map, Modify, Monitor, Optimize, Plot, Proceduralize, Rationalize, Rehearse, Schedule, Think Ahead, Understand	1
Know, Execute, Perceive	0
Get info, Navigate, Manage	-1
React, Direct	-2

TABLE 6
Tactical verb discriminative value scores.

Verbs	Score
Act	11
Fly, Respond	6
Do	5
Avoid, Control, React	4
Move	3
Accomplish, Carry Out, Maneuver, Perform	2
Assess, Aviate, Communicate, Compensate, Generate, Implement, Intercede, Observe, See, Take Emergency Action	1
Evaluate, Concentrate, Point	0
Get info, Direct, Manage, Navigate	-1
Perceive, Decide	-2

The following verbs received a score of 0 or less and can therefore should not be considered as discriminators between tactical and strategic behaviors: Get Information, Navigate, Know, Execute, Manage, Perceive, Understand, Direct, Concentrate, and Point.

Close scrutiny of the sentence descriptions provided by the SMEs reveal other aspects not implicated in the verb descriptors. One of the aspects is time. Many of the SMEs viewed time as a discriminator with tactical being short-term and strategic being long-term. The time thresholds (mentioned in the narratives) between tactical and strategic ranged from 2 to 20 minutes ahead. Another distinction was the type of processing that is occurring, namely skill-based, rule-based, or knowledge-based. Skill and rule were primarily tactical and knowledge-based was primarily strategic. Goal aggregation or abstraction was also used to distinguish between the two. Strategic behavior dealt more with high-level goals for the overall mission. The scope of these goals is much broader than that of tactical goals. In military terms, tactical goals are concerned with winning the battle while strategic goals are concerned with winning the war. Similarly the scope or breadth of information also appeared to discriminate with strategic information having a broader scope in terms of types of information with less detail (or depth) than tactical information. Another prominent discriminator had to do with whether the pilot was on the flight deck – both physically or mentally. That is, strategic behavior was that behavior that could occur outside the flight deck or when there was “nothing” required to be done on the flight deck. Tactical behavior requires the pilot to be mentally and physically present on the flight deck. One quote is worth repeating regarding this distinction in that it may be a contributing factor to confusion in the flight deck: “Once airborne, strategic and tactical considerations are often inseparable.”

Discussion

The verb descriptors seem to point toward the difference between planning and carrying out those plans. Tactical verbs are more action-oriented verbs that change the state of the world after they have been accomplished. Strategic verbs are more prescriptive in that they do not change the state of the world but offer a procedure or program for changing the world. It is interesting that the verb “Think” is second behind “Plan” in strategic behavior. One way of describing the difference is that strategic behavior is thinking about doing it and tactical is actually doing it. Along those lines, the definitions for the strategic verbs use the term “mind” nine times and the term “mental” two times, whereas “mind” is not found in the definitions for tactical verbs and “mental” is found only once in the definition for “see.” The implication from this is that strategic behavior occurs more in the mind than in the actual world. This was expressed in one of the comments that stated that strategic behavior could occur outside of the flight deck, whereas tactical behavior must occur in the aircraft.

Therefore, one possible way of describing the difference between tactical and strategic behavior is to view the tactical mode as actually moving the aircraft whereas the strategic mode is used for thinking about moving it (i.e., planning, prognosticating, and preparing). Tactical behavior means being immersed in the here-and-now of the situation and limited to the information currently available. Strategic behavior allows the pilot to rise above (ahead of and out of) the situation and look at the big picture, look ahead and behind, and evaluate the current situation and future situations in light of goals and values. This is consistent with the view that the navigation display and the FMS represent strategic devices in that they present a “God’s eye view” or “Plan view” that can interact with and describe situations far from the aircraft’s current position (e.g., planning a landing at the destination shortly after take off, or planning an alternate that will likely never be taken.)

Resource Allocation and Information Processing

Since the human’s information processing capability has some upper bound, the increase in scope involved in strategic behavior (e.g., looking at the big picture) usually requires a decrease in detail. Likewise, the human must have spare resources to rise above the tactical in order to think strategically. If the tactical environment is a high-workload one or greatly time-pressured, the pilot may not have the resources available for strategic behavior. In this sense, strategic behavior is optional, but tactical is required. At each moment, you must do something (even if that something is nothing.) You do not have to think about it.

This interpretation brings to the fore the need for a dynamic balance between tactical and strategic behavior. If a pilot is too immersed in a particular problem or situation (e.g., systems failure or heavy weather), he may lose sight of the big picture (e.g., terrain or fuel state). Likewise, if the pilot is overly concerned with future and broad consequences and information, he may overlook some critical tactical detail (e.g., gear position).

Counterintuitive Results

There were two surprises from this analysis – two verbs that were expected to be strongly associated with a category were not. *Navigate* was expected to be associated with Strategic, but it received a score of 0 indicating that it was not a good discriminator between tactical and strategic. The definition for *Navigate* provides some insight. It describes navigating as both planning a route and then following that route or course. For example, I can navigate around rocks and rapids when white water rafting or I can navigate a route on charts. Thus, it is both planning and doing.

Similarly, *Execute* was expected to be associated with Tactical. The definition for *Execute* is loaded with action verbs such as do, perform, and carry out. Yet it was mentioned once — only in the Strategic verbs! Perhaps this is due to the usage of the word; for example, you may hear that someone may execute a strategy, but you don’t use the phrase “execute a tactic.” It is strongly worth noting that there is an EXECUTE button on the FMS CDU that is used to couple the plan in the FMS to the guidance system in the aircraft. Here, *Execute* represents a bridge from strategic to tactical.

Confusion Arising from Tactical and Strategic

Returning now to the flight deck, we can take a preliminary look at the distinction of the FMS CDU as a strategic device and the inceptors and MCP as tactical devices. At first it appears that they do indeed fit the definitions. The FMS can be used to plan a flight; and the inceptors and MCP can be used to carry out that plan. However, closer inspection shows that the FMS is not used exclusively for planning. It is used for moving the aircraft in that a plan in the FMS can be directly coupled to the autopilot and therefore result in movement in the aircraft. The pilot can make changes in the FMS that will cause the aircraft to move and move right now. In short, the pilot can configure the FMS to be used as a tactical device.

Similarly, the MCP can be used in a strategic manner. The altitude indicator is often used as a limit on the aircraft's altitude rather than a control. For example: The aircraft can be planned to eventually ascend to 30,000 feet based on commands from the FMS. The pilot can dial in 25,000 feet while the aircraft is at 10,000 feet. This will not have any immediate effect on the aircraft. If the FMS did not drive the aircraft above 25,000 feet, this action would never have any effect. It will only come into play later in the flight when the FMS drives the aircraft to ascend to 30,000. Rather than ascending to 30,000 feet, it would level off at 25,000 feet. It is often the case that situations like these cause the pilot to wonder what the aircraft is doing. While this is not the only source of confusion arising from the modern flight management system, I believe that it is a major contributor.

It would be interesting to design a flight management system that was based on the distinction of tactical and strategic that has been described here. That is, one set of controls and displays for actually moving the aircraft and another set of controls and displays for planning the movements of the aircraft. The planning system could be used for providing guidance to the pilot for tactically moving the aircraft, but changes in the plan would not actually move the aircraft.

Conclusion

Seventeen subject matter experts provided opinions on the definitions of tactical and strategic within the aviation domain. These experts provided five verbs and a sentence describing both tactical and strategic behavior. The verbs most often mentioned exclusively for strategic behavior were Plan, Think, Arrange, Formulate, Intend, Devise, Anticipate, and Order. The verbs most often mentioned exclusively for tactical behavior were Act, Fly, Respond, Do, Avoid, Control, React, and Move. Just as interesting were the verbs that were common to both tactical and strategic were Get Information, Navigate, Know, Execute, Manage, Perceive, Understand, Direct, Concentrate, and Point. A person can navigate, manage, and direct in either a tactical sense or in a strategic sense.

The responses seem to point toward the difference between planning (strategic) and carrying out those plans (tactical). Tactical verbs are more action-oriented verbs that change the state of the world after they have been accomplished. Strategic verbs are more prescriptive in that they do not change the state of the world but offer a procedure or program for changing the world. The pilot is in a tactical mode when actually moving the aircraft and in a strategic mode when thinking about moving it (i.e., planning, prognosticating, and preparing).

The results of this study represent a first step toward designing a flight deck that better matches the human's mental model and intuition. Further study will be required to see if these concepts of tactical and strategic are similar in various pilot communities (e.g., airline pilots, general aviation pilots).

Acronym List

ATC	Air Traffic Control
CDU	Cockpit Display Unit (or Control and Display Unit)
FMS	Flight Management System
MCP	Mode Control Panel
NASA	National Aeronautics and Space Administration
PFD	Primary Flight Display
SME	Subject Matter Expert
US	United States

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Appendix A: Subject Matter Expert Backgrounds

SME 1

Aviation Human Factors Researcher for US Avionics manufacturer

SME 2

Aviation Human Factors Researcher for NASA

SME 3

Flight Deck Systems Researcher for NASA

SME 4

Flight Deck Design Researcher for US Airframe manufacturer

SME 5

Flight Deck Design Researcher for US Airframe manufacturer

SME 6

Flight Deck Design Researcher for US Airframe manufacturer
Former Test Pilot for US Airframe manufacturer

SME 7

Flight Deck Design Researcher for NASA
Private Pilot and Flight Instructor

SME 8

Flight Deck Systems Researcher for NASA

SME 9

Flight Deck Systems Researcher for NASA
Private Pilot

SME 10

Flight Deck Design Researcher for NASA
Private Pilot
Former Military Pilot

SME 11

Flight Deck Design Researcher for US Airframe manufacturer

SME 12

Flight Deck Design Researcher for NASA
Private Pilot

SME 13

Former Airline Captain
Former Military Pilot

SME 14

Flight Deck Design Researcher for US Airframe manufacturer

SME 15

Aviation Human Factors Researcher for NASA

SME 16

Aviation Human Factors Researcher for US Avionics manufacturer

SME 17

Flight Deck Design Researcher for NASA

Appendix B: SME Complete Comments

SME 1

TACTICAL

Relates to immediate tasks, setting and accomplishing short-term goals, performing and responding quickly without time for knowledge-based reasoning, high workload situations in which pilot attention and workload is focused on accomplishing items with near-in deadlines, working in "real time."

STRATEGIC

Thinking ahead of the airplane, mission & flight planning, setting long-term goals and plans for accomplishing goals, knowledge-based reasoning about issues/plans/problems, contingency planning, anticipating future events — concern about future states and situations vs current states and situations.

Primary distinguishing factor: focus on near term vs far term goals & tasks — not sure what the magic number is for time, but probably in the neighborhood of <5 minutes (maybe as low as <2 minutes) is tactical.

Secondary distinguishing factor: workload/ number of tasks requiring immediate attention

SME 2

TACTICAL

Tactical behavior includes all immediate activity in response to external stimuli and required as a means of accomplishing pre-established goals pertaining to a strategy. Tactical Flight Path Management means active aircraft maneuvering for immediate response. Tactical communication is issuing an instruction that is immediately relevant or responding to another agent.

STRATEGIC

Strategic behavior derives from the mission and serves to identify the methods, and (lower) actions required to accomplish this mission; this can include strategies for contingencies. Strategic Flight Path Management includes route planning, identifying contingency conditions and methods for coping with them. Strategic communication takes the form of dissertation, for example maybe the change-over conversation they give each other in that it serves no immediate purpose but it used to maintain the big picture. Strategic systems management is determining conditions under which you should actively manage things (fuel balance?), determining procedures over different systems to achieve a higher order goal.

SME 3

TACTICAL

Tactical behavior in the cockpit is planning for flight tasks/maneuvers currently in progress or ones in the immediate future. Tactical behavior is reactionary.

STRATEGIC

Strategic behavior in the cockpit is planning for flight tasks/maneuvers in the future not ones currently happening. Strategic behavior is more proactive than reactive because there is time to plan for future flight tasks maneuvers.

SME 4

No Narratives only verbs

SME 5**TACTICAL**

Actions or plans related to short-term goals

STRATEGIC

Actions or plans related to long-term goals

SME 6**TACTICAL**

Tactical requirements, tasks, and behaviors are associated with direct control of the vehicle - what it is that the pilot needs to do to directly affect the flight path or critical systems. Tactical requirements are often immediate, and emphasize what it is that needs to be done, rather than the rationale for doing it. A tactical requirement, for example, would be to alter pitch attitude to a specific value at initiation of a missed approach.

STRATEGIC

Strategic requirements, tasks and behaviors relate to situation awareness - the integrated understanding and correlation of the myriad of variables that affect vehicle flight path and systems management. Strategic issues focus on the rationale for present and future actions, and relationships between present and future requirements. A strategic requirement, for example, would be the need to request a long straight-in approach to the longest runway at a given airport, following a flap system failure.

SME 7**TACTICAL**

Tactical behaviors are near-term or current-action means to fly (aviate) the airplane. Keep it right-side up. To navigate—what actions are required to fly a specific heading or to attain a specific altitude or vertical speed or to attain a specific airspeed.

STRATEGIC

Strategic behavior is deciding what appropriate actions should be taken later on—long-range planning, reviewing approach, missed approach, and landing procedures, planning contingencies or what-ifs, etc.

SME 8**TACTICAL**

Looking at the short-term goals of the flight and immediately acting to fulfill those goals. Hopefully, these actions were previously thought out and are part of an overall strategy.

STRATEGIC

Determining the general goal(s) and relative importance of each for the flight and deciding which actions to take and when to take them (so that they then become tactical at the appropriate time) in order to achieve the general goal(s).

SME 9**TACTICAL**

Tactical behavior is the identification of a circumstance/situation/condition with near-term implications and the implementation of a trained/pre-established response to rapidly mitigate the situation.

STRATEGIC

Strategic behavior is the identification or "gaming" of a circumstance/situation/condition with future implications and the development of a plan of action to cause the situation to be resolved in a manner favorable to your desires.

SME 10**TACTICAL**

Controlling the current state of the vehicle. This would include navigation (where am I) and guidance (where should I be & how do I get there).

STRATEGIC

Planning the future state of the vehicle. This would include navigation (where am I going) and guidance (how do I get there).

SME 11**TACTICAL**

More immediate/non planned (flight); manual flying (side issue: what does manual mean? say, if we have the auto throttle on, does this take the mission out of tactical or not?)

STRATEGIC

Planned flight;

May want to relate the two concepts (TACT/STRAT) to display-oriented tasks and/or flight phases;

Primary tactical flight phases: Takeoff & Landing

Primary strategic flight phases: Cruise

SME 12**TACTICAL**

Tactical behavior on the flight deck is characterized by a short-term focus, as in carrying out the steps of previously made plans and responding to minor events which affect not the plans themselves, but the immediate actions that are being taken.

STRATEGIC

Strategic behavior on the flight deck is characterized by a long-term focus (with respect to the duration of the flight), as in planning the route and responding to major events which render existing plans unworkable or undesirable.

SME 13**TACTICAL**

Tactical behavior deals with the immediacy of ever-changing situations.

STRATEGIC

IMHO, much strategic behavior takes place before entering the cockpit. It probably begins with learning the time and destination of the flight. This initiates a cognitive review that includes study of the airports, routes, probable weather and special procedures. The strategic behavior continues during the flight planning period with consideration to weather, airplane condition and crew considerations. Once airborne, strategic and tactical considerations are often inseparable. For example, avoiding a line of thunderstorms is a tactical maneuver but the extra fuel consumed may cause a strategic reevaluation of the destination holding fuel or alternate.

SME 14**TACTICAL**

Tactical behavior is that of flying the airplane. This will include all airplane maneuvering with the primary flight controller and throttles. It includes use of autopilot, changes to the airplane configuration, and communications with ATC.

STRATEGIC

Strategic behavior is that of planning and managing the flight. This will include preflight planning, programming and updating of the flight management computers, referencing and briefing en route chart and arrival information, and communications with operations and ATC. It includes in-flight planning and route modification due to weather, traffic flows, fuel management, etc.

SME 15**TACTICAL**

Tactics are what you do when you have to do something (e.g., climb, descend, avoid hitting an aircraft, report in, respond to ATC)

STRATEGIC

Strategy is what you do when there's nothing to do (e.g., prepare for approach/landing during cruise, preflight brief, flight plan, etc.)

SME 16**TACTICAL**

I see Tactical as describing current activities. I see this as Monitoring (current state variables), Assessing (with regards to immediate actions), and Modifying/Controlling (current state variables, including aircraft systems).

STRATEGIC

I think of Strategic behavior as Planning or Determining Actions.

I wanna fly from HERE to THERE. After the NEXT WAYPOINT I WANNA DO THE FOLLOWING ... I want the cabin altitude to be controlled automatically

If there is anything "different" about my viewpoint I would highlight the notion that there is no distinction between aircraft systems along the TACTIAL/STRATEGIC boundary. Aircraft Systems are not simply one or the other. It all depends on the timeliness of input/response which separates TAC/STRAT for me.

SME 17**TACTICAL**

Tactical behaviors on the flight deck are short-term, expeditious techniques to achieve a limited or temporary advantage.

STRATEGIC

Strategic behaviors on the flight deck are any part of a series of operations or procedures used to achieve large-scale and lasting objectives.

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